(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 February 2004 (05.02.2004)

PCT

(10) International Publication Number
WO 2004/010762 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/US2003/023488

(22) International Filing Date: 29 July 2003 (29.07.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/399,263 29 July 2002 (29.07.2002) US

(71) Applicant *(for all designated States except US)*: **S.C. JOHNSON & SON, INC.** [US/US]; 1525 Howe Street, MS 077, Racine, WI 53403 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WALTER, Scott, D.** [US/US]; 118 Walnut Road, Village of Twin Lakes, WI 53181 (US). **WOLF, Jeffrey, J.** [US/US]; 6443 Anforest Lane, Racine, WI 53406 (US). **PORCHIA, Jose** [US/US]; 11787 Armour Court, Greenfield, WI 53228 (US). **TOMKINS, David, A.** [US/US]; 77 Eldorado Drive, Racine, WI 53402 (US). **HELF, Thomas, A.** [US/US]; 12780 West Weatherstone Court, New Berlin, WI 53151 (US). **CRASPER, James, R.** [US/US]; 8530 Northwestern Avenue, Racine, WI 53406 (US).

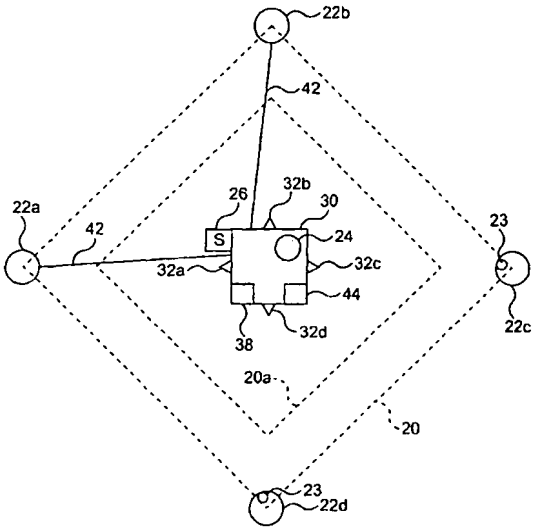
(74) Agents: **MILLER, Robert, A.** et al.; S.C. Johnson & Son, Inc., Patent Section, M.S. 077, 1525 Howe Street, Racine, WI 53403-2236 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SYSTEM FOR CONTROLLING INSECTS



(57) Abstract: An insect control system for controlling insects within a predetermined area (20). The system includes a plurality of insect control devices distributed throughout the predetermined area, the insect control devices including at least one device that emits an insect repellant (24) and at least one spaced apart device that emits an insect attractant (22a-22d). A sensor (26) senses at least one ambient condition and emits one or more corresponding signals to a central control device (30). The central control device (30) is arranged to respond to the corresponding signals and to emit activation signals which control the operation of the insect control devices according to the corresponding signals.

WO 2004/010762 A2

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE

System for Controlling Insects

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the control of insects and more particularly it concerns novel methods and apparatuses for reducing the amount of insects in selected locations such as rooms or yard areas.

Description of the Related Art

Electrically controlled and electronically controlled insect reduction devices are well known. U.S. Patent No. 5,115,975 discloses a device for emitting a vaporized substance, such as an insecticide, into the atmosphere according to the setting of a timer. U.S. Patent No. 6,135,369 discloses an electrostatic sprayer that sprays insecticides, which can be controlled according to selected on times and off times, and which incorporates a sensor to sense the available power for continued operation. U.S. Patent No. 4,689,515 discloses an ultrasonic liquid atomizer with automatic frequency control. U.S. Patents No. 3,543,122 and No. 3,615,041 disclose aerosol dispensers having timers for controlling the operation of the dispensers according to preset times.

SUMMARY OF THE INVENTION

None of the prior art devices employs different devices which operate cooperatively and in accordance with sensed conditions and/or according to predetermined programs for controlling insects within a defined area, such as a room or a yard area. Also, none of the prior art devices can be operated so as to provide, in addition to insect control, desired lighting effects, fragrance conditions and/or entertainment, such as music.

According to one aspect, our invention provides a novel insect control system for controlling insects within a predetermined area. This novel system comprises a plurality of insect control devices, at least one sensor and a central control device. The insect control devices are distributed throughout the predetermined area; and they include at least one device that emits an insecticide (which may be a chemical or other agent, such as sound waves) and at least one spaced apart device that emits an insect repellant and/or at least one adjacent device that emits an insect attractant (the repellant and attractant may also be chemicals or other agents, such as electromagnetic waves). The sensor senses any one of a number of ambient conditions including, at least, temperature, humidity, wind speed, wind direction, light, sound, and motion. These, and other sensed conditions, may be used to detect the presence of humans or insects, conditions that may affect the dispersement of insect control agents, the time of day, etc. The sensors also emit signals corresponding to the sensed conditions. The central control device is arranged to respond to the sensor signals and to emit activation signals which control the operation of the insect control devices according to the corresponding signals.

According to another aspect, our invention provides a novel method of controlling insects within a defined area. This aspect involves emitting an insect repellant at a first location in a region near the center of the area and emitting an insecticide in at least one second location in the vicinity of the periphery of the area.

According to another aspect, our invention provides a novel insect control system in which at least one insect repellant device, which is located near the center of an area to be controlled, such as a room or a yard area, is a lamp (which emits electromagnetic waves, inside and/or outside the visible spectrum), an acoustical device (which emits sound waves) or an atomizing device (which emits airborne droplets); and at least one insect killing device, which is located near the periphery of the area, is an acoustical or an atomizing device. In this aspect, at least one insect attractant device, which may be one or more lamps, acoustical devices or atomizing devices, may be located close to the insect killing device or devices near the periphery of the area.

According to a further aspect, our invention provides a novel insect control system which comprises at least one electrical lamp and at least one electrically controlled liquid atomizing device located adjacent each other in an area to be controlled. One of the lamp and the atomizing device is capable of emitting an insect attractant and the other device is capable of emitting an insecticide.

According to a still further aspect of our invention, an insect control system is provided which comprises at least two electrically controlled liquid atomizing devices. At least one of the atomizing devices is capable of emitting an insect repellant in a region near the center of an area to be controlled and another atomizing device is capable of emitting an insecticide in a region near the periphery of the region to be controlled.

In a still further aspect, our invention involves an insect control system which comprises at least one electrically controlled liquid atomizer device and one electrical lamp, which are positioned and arranged to operate cooperatively to control insects within a defined area. The insect control system further comprises a central programmed controller which is electrically connected to the atomizer devices and to the lamp. The controller is constructed to produce control signals for controlling the atomizer device and the lamp. Each of the atomizer device and the lamp has an identifying code and the control signals each include at least one of the identifying codes.

According to yet another aspect, our invention provides an insect control system which comprises a plurality of electrically controlled devices positioned and arranged to operate cooperatively to control insects within a defined area and a central programmed controller electrically connected to the devices and constructed to produce control signals for controlling the devices. Each of the devices has an identifying code and the control signals each include at least one of the identifying codes. The electrically controlled devices may comprise one or more of liquid atomizing devices, electrical lamps and/or acoustical devices. These devices are constructed so as to be capable of producing emissions which act as an insect attractant, an insect repellant or an insecticide.

In a still further aspect, our invention involves an insect control system having an insect repelling device for repelling insects, operating in a first area, and at least one insect control device, the insect control device being at least one of an insect attracting device and an insect killing device, and the at least one insect control device operating in a second area different from the first area. Further, a controller independently controls the insect repelling device and the at least one insect control device to operate in their respective areas.

According to another aspect, our invention provides an insect control system which comprises a plurality of insect control devices, the insect control devices including at least one of an insect attracting device, an insect killing device, and an insect repelling device. Also, a controller controls the plurality of insect control devices and a sensor senses an ambient condition in an area in which insects are to be controlled by the insect control system. The controller controls the plurality of insect control devices based on the at least one ambient condition sensed by the sensor.

According to another aspect, our invention provides an insect control system including a plurality of insect control devices, the insect control devices being at least one of an insect attracting device, an insect killing device, an insect repelling device. The plurality of insect control devices are independently arranged in an area in which insects are to be controlled. A controller independently controls the plurality of insect control devices to control insects in the area to be controlled.

According to yet another aspect, our invention provides an insect control system having a plurality of insect control devices, the insect control devices being at least one of an insect attracting device, an insect killing device, and an insect repelling device. The plurality of insect control devices are independently arranged in an area in which insects are to be controlled. A lamp is also provided for emitting ambient light. A controller independently controls the plurality of insect control devices to control insects in the area to be controlled and the lamp to emit light.

In an even more preferred embodiment, our invention provides an insect control system having a plurality of dispensers for emitting an insect control agent, each dispenser being independently positionable, and the insect control agent being at least one of insect repellant, insect attractant and insecticide. Also, a controller controls the emission of the insect control agent from each of the plurality of dispensers and a sensor senses an ambient condition. The controller controls the dispensing of the insect control agent from each of the plurality of dispensers, individually, based on the ambient condition sensed by the sensor.

In a most preferred embodiment, our invention provides an insect control system including a plurality of dispensers for emitting an insect control agent, the insect control agent being at least one of an agent for repelling insects, an agent for attracting insects, and an agent for killing insects. A controller controls the emission of the insect control agent from each of the plurality of dispensers and a sensor senses an ambient condition. The controller controls the emission of the insect control agent from each of the plurality of dispensers based on the ambient condition sensed by the sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatic plan view of a first arrangement of an electrically operated insect control device according to our invention.

Fig. 2 is a diagrammatic plan view of a second arrangement of an insect control device according to our invention.

Fig. 3 is an elevational cross-sectional view of an atomizer-type control device for use in a preferred embodiment of our invention.

Fig. 4 is an enlarged fragmentary cross-sectional view of a portion of the atomizer-type control device shown in Fig. 3.

Fig. 5 is a schematic circuit diagram of a preferred controller for use in our invention.

Fig. 6 is a flow chart showing a program for use in controlling the circuit shown in Fig. 5.

Fig. 7 is a "look-up" table for use with the program shown in Fig. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in Fig. 1, an area 10 to be controlled for insects is defined by a perimeter line 12. The line 12 may be the walls of a room or a fence in a yard. Actually, if less than complete insect control is desired within the area 10, the perimeter line 12 need not be a physical barrier.

A plurality of electrically operated insect control devices 14a (which are capable of repelling insects), 14b (which are capable of attracting insects), and 14c (which are capable of killing insects) are arranged within the area 10. The insect control devices 14a and 14b, which are capable of attracting and repelling insects, may be liquid atomizer devices, lamps and/or acoustical devices. The insect control devices 14a, which are capable of repelling insects, are located in the interior of the area 10. The insect control devices 14b, which are capable of attracting insects, and the insect control devices 14c, which are capable of killing insects, are located toward the periphery of the area 10. Also distributed throughout the area 10 are sensors 16. Each of these sensors senses the insect concentration in the particular region where the sensor is located (i.e., through specialized motion sensors or sound sensors that detect sounds, or sounds at specific frequencies).

A central control device 18 is located within or near the area 10. The central control device is configured and arranged to receive signals from the sensors 16 either by way of wire connection or by non-wire means such as radio waves, infrared signals or acoustical signals. The central control device 18 in turn is arranged to transmit signals to the insect control devices 14 either by way of wire connection or by non-wire means such as radio waves, infrared signals or acoustical signals. In the situation where the sensors 16 communicate with the central control device 18 by non-wire means or via a common bus line, the sensors are provided with signal transmitters (not shown). Also, the signals from the sensors 16 are

pre-coded to identify the particular sensor from which they originate. Also, in the situation where the central control device 18 communicates with the several insect control devices 14 by non-wire means or by means of a common bus, the signals from the central control device 18 are pre-coded to identify the particular insect control device 14 to be operated. It will be understood that the central control device 18 and the insect control devices 14a, 14b and 14c are provided with appropriate receivers and decoders which permit the central control device 18 to operate according to the particular sensor from which it receives signals and to direct control signals to appropriate ones of the insect control devices 14a, 14b and 14c.

The signals from the central control device 18 turn the respective insect control devices 14a, 14b and 14c on and off, and/or they may be coded to adjust the output intensity of the respective insect control devices. These signals may be coded by appropriate modulation, for example, frequency modulation, amplitude modulation, pulse width modulation or phase shift modulation.

The electrically operated insect control devices 14a, 14b and 14c may be any of several known electrically operated devices that attract, repel or kill insects within a certain distance from the device. These insect control devices may comprise aerosol or atomizer devices which atomize liquids into very small droplets and eject the droplets into the surrounding atmosphere. Depending on the particular arrangement used, as described hereinafter, the liquid which is atomized in these atomizer or aerosol devices may be an insect repellant, an insect attractant or an insecticide. One type of device that is especially suitable is a vibrating orifice plate device which is vibrated by a piezoelectric actuator.

The insect control devices 14a, 14b and 14c may also include lamps capable of emitting electromagnetic radiation (inside and/or outside the visible spectrum) at frequencies which, depending on the application, may be selected to repel or attract insects within a certain distance. Further, the insect control devices may include acoustical generators which, again depending on the application, emit sound waves or acoustical vibrations having frequencies selected to repel, attract or kill insects within a certain distance.

As shown in Fig. 1, the insect control devices 14a, which repel insects, are arranged in the interior regions of the area 10, while the insect control devices 14b that attract insects and the insect control devices 14c that kill insects are located near the periphery of the area. The sensors 16 are distributed throughout the area 10. When one of the sensors 16 senses a high concentration of insects near its location in the area 10, that sensor transmits an activate signal to the central control device 18. The central control device in turn sends signals to selected ones of the insect control devices 14a, 14b and 14c in the region of the sensor 16 which transmitted the activate signal. The insect control devices 14a, which repel insects, and the insect control devices 14b, which attract insects, act cooperatively to drive the insects toward the insect control device (or devices) 14c, which kills them.

It will be appreciated that by repelling insects from the devices 14a toward the insect killing devices 14c, the amount of killing energy or chemical insecticide needed by the killing devices 14c is reduced. It will also be appreciated that only those insect control devices, which are in the vicinity of the sensor 16, which transmits the activate signal, are turned on. In this manner, the unnecessary expenditure of chemicals and/or electrical energy is avoided.

As other sensors 16 sense the presence of insects at different locations within the area 10, those other sensors may send signals to the central control device 18, which in turn activates the insect control devices associated with the different locations. In this manner, particular locations may be controlled selectively and with high efficiency.

As mentioned above, the insect control devices 14a, 14b and 14c can be of a type which emits a mist of small liquid droplets. Also, these devices may be of a type which emits electromagnetic radiation, such as light; or they may be of a type which emits acoustical radiation, such as sound or ultrasound waves. Different types of these devices may be used together. These types of insect control devices may be constructed to repel insects, attract insects or to kill insects. For example, an insect control device of the type which emits a mist of small liquid droplets may emit insect attractants such as pheromones, insect repellants such as N, N-Diethyl-M-Toluamide (Deet) or insecticides such as pyrethrin. An insect control device of the type which emits electromagnetic radiation may comprise light

generators or other high frequency electromagnetic radiation emitters. The frequency of the emitted radiation will determine whether the energy acts as an insect repellant or an insect attractant. An insect control device of the type which emits acoustical radiation may comprise loudspeakers which are driven to produce sound or ultrasound waves at different frequencies that either repel or attract insects.

What is important is that the insect control device or devices which kill insects be positioned close to the device or devices which attract insects, and away from the device or devices which repel insects.

It is also possible to configure the central control device 18 so that it operates according to a timed program to actuate the different insect control devices at different intervals or in predetermined combinations. In addition, fragrance dispensers, other lights and/or other speakers may be provided which do not have a direct effect on insect control but which provide entertainment or desired ambient conditions, and are operated in conjunction with the above described insect control features of the invention. These other fragrance dispensers, lights and/or speakers may also be controlled by the central controller 16. In some cases, the same insect control devices which are used to dispense insect repellants, insect attractants and insecticides can be modified to provide desired fragrance, light or sound in response to signals from the central control device 18.

As described above, the signals from the central control device 18 are initiated by activation signals from the various sensors 16. The central control device 18 may also be constructed to receive override signals which are input manually or from a remote transmitter to operate the insect control devices or other devices such as fragrance dispensers, lights and/or speakers in any desired manner, or which can change over the operation of the insect control devices to provide desired fragrance, light or acoustical conditions. In preferred embodiments, the system may include a lamp (or lamps) comprised of light emitting diodes (LEDs) of a single color or multiple colors. Accordingly, the LEDs can be controlled to provide suitable ambient light, or light shows, of single or multiple colors. Further, such lights can be easily controlled, as is known in the art, to work by user controlled settings or

preprogrammed settings to provide the necessary ambient light. Such ambient conditions and control mechanisms can be provided by systems such as those shown in PCT/US03/14769, which is incorporated herein by reference.

Figure 2 shows another embodiment of our invention. In this embodiment, a plurality of insect control devices are provided, including attractant dispensers 22a-22d, which emit insect attractant, and repellant dispenser 24, which emits insect repellant (although any of a number of insect attractant and repellant devices may be used, as discussed above, atomizing dispensers are discussed with respect to this embodiment, for exemplary purposes). The attractant dispensers 22a-22d are provided at the periphery of area 20; however, the attractant dispensers may also be arranged at the periphery of a second area 20a, as discussed in more detail below. The attractant dispensers may also be positioned throughout the area 20, so long as the attractant dispensers 22a-22d are positioned to attract insects away from an area to be occupied by users.

Optionally, the insect control devices may also include insecticide dispensers 23, which emit insecticide. In this example, insecticide dispensers 23 are provided integrally with the attractant dispensers 22. In other embodiments, the insecticide dispensers 23 may be provided separate from the attractant dispensers 22, in lieu of the attractant dispensers 22, or not at all. The repellant dispenser 24 is preferably provided at or near a central portion of the predefined areas 20and 20a. In other embodiments, a plurality of repellant dispensers 24 may be provided. Preferably, a plurality of repellant dispenser 24 may surround a central portion of at least one of the predefined areas or be arranged throughout the predefined areas.

Various insect control substances are known in the art and could be chosen by one of ordinary skill in the art for use with the attractant dispensers 22a-22d, insecticide dispensers 23 and repellant dispenser 24, as discussed above.

Dispensers for emitting insect control substances are also known in the art. A variety of different types of dispensers may be used to construct our invention, including

piezoelectrically actuated atomization devices, heat-assisted evaporation devices, fan-assisted evaporation devices, aerosol spray devices, lamps, and acoustical generators, among others. Even within each type of dispenser, variations are possible, as would be appreciated by one of ordinary skill in the art.

A more preferred dispenser uses an atomizer that releases droplets of insect control substances/chemicals into the air. In such a case, a control substance is supplied in liquid form to the dispenser and is atomized in the dispenser by any of various controllable means, for example, by an orifice plate that is vibrated by a piezoelectric actuator. Examples of mechanical atomization devices are shown and described in U.S. Patent Nos. 6,292,196 and 6,341,732.

In addition, Figure 3 shows a preferred atomizer for use in our invention. As shown in Figure 3, a piezoelectrically actuated atomization device 70 generally comprises an atomizer assembly 34, which includes an orifice plate 37, and a replaceable reservoir assembly 80. The reservoir assembly 80 includes a reservoir 31 containing fluid and a wick 107. When one reservoir assembly 80 is removed by a user and replaced with another reservoir assembly, the wick 107 instantaneously delivers fluid to the orifice plate 37.

The atomization device 70 comprises a housing 72 formed as a hollow plastic shell. A horizontal platform 25 extends across the interior of the housing 72. A battery 76 is supported by means of support prongs 25a which extend down from the underside of the platform 25 inside the housing 72. In addition, a printed circuit board 28 is supported on support elements 25b which extend upwardly from the platform 25. A liquid reservoir assembly 80 is replaceably mounted to the underside of a dome-like formation 25c on the platform 25.

The liquid reservoir assembly 80 comprises a liquid container 31 for holding a liquid to be atomized, a plug 33, which closes the top of the container, and the wick 107, which extends from within the liquid container 31 through the plug 33, to a location above the liquid container 31. The plug 33 is constructed to allow removal and replacement of the complete

liquid reservoir assembly 80 from the underside of the dome-like formation 25c on the platform 25. Preferably, the plug 33 and the platform are formed with a bayonet attachment (not shown) for this purpose. When the replaceable liquid reservoir assembly 80 is mounted on the platform 25, the wick 107 extends up through a center opening in the dome-like formation 25c. The wick 107, operates by capillary action to deliver liquid from within the liquid container 31 to a location just above the dome-like formation 25c on the platform 25.

An atomizer assembly 34 is supported on the platform 25 in cantilever fashion by means of a resilient, elongated wire-like support 77. As is described more fully in copending U.S. Patent Application No. 10/304,215, filed November 26, 2002, assigned to the assignee of this invention, in the preferred embodiment, the wire-like support 77 is attached at its ends to posts, which protrude upward from the platform 25. The support 77 is shaped such that it resiliently supports the lower surface of the orifice plate 37 and a spring housing 39, while a spring 43 resiliently presses on the upper surface of an actuator element 35. Together, the support 77 and the spring 43 hold the orifice plate 37 in place in a manner that allows the orifice plate 37 to move up and down against the resilient bias of the wire-like support 77.

The atomizer assembly 34 comprises an annularly shaped piezoelectric actuator element 35 and the circular orifice plate 37, which extends across and is soldered or otherwise affixed to the actuator element 35. A construction of a vibrator-type atomizer assembly is known and is described, for example, in U.S. Patent No. 6,296,196, which is incorporated herein by reference. Accordingly, the atomizer assembly 34 will not be described in detail except to say that when alternating voltages are applied to the opposite upper and lower sides of the actuator element 35, these voltages produce electrical fields across the actuator element and cause it to expand and to contract in radial directions. This expansion and contraction is communicated to the orifice plate 37 causing it to flex so that a center region thereof vibrates up and down. The center region of the orifice plate 37 is domed slightly upward to provide stiffness and to enhance atomization. The center region is also formed with a plurality of minute orifices which extend through the orifice plate 37 from the lower or

under surface of the orifice plate 37 to its upper surface. A flange is provided around the center region of the dome.

In operation, the battery 76 supplies electrical power to circuits on the printed circuit board 28 and these circuits convert this power to high frequency alternating voltages. (Of course, in other embodiments, power may be provided by an AC power supply, by wired connection to a controller 30, discussed below, or by other conventional means.) A suitable circuit for producing these voltages is shown and described in U.S. Patent No. 6,296,196, noted above. As described in that patent, the device may be operated during successive on and off times. The on and off times may be controlled by a preset program, a user interface working through a processor, or by the logic of controller 30, discussed in more detail below. To achieve this end, the atomizer device 70 includes interface 98, which receives signals from the controller 30. The interface 98 may receive signals from a direct connection via a wire, or through a wireless transmission from the controller 30. In alternative embodiments, the interface 98 may be a transceiver for both receiving signals from and sending signals to the controller 30. The signals to be sent from the atomization control device 70 could relate to the need to refill/replace the liquid reservoir 31 or ambient conditions surrounding the atomization control device 70. In this case, the atomization control device 70 may be provided with suitable sensors and circuitry for generating signals based on the sensed information. Such modifications would be readily understood by one of ordinary skill in the art. Sensors may also be provided separate from the dispenser, as discussed above and below.

When the atomizer assembly 34 is supported by the support member 77, the flange of the orifice plate 37 is positioned in contact with the upper end of the wick 107. The atomizer assembly 34 is thereby supported above the liquid reservoir assembly 80 such that the upper end of the wick 107 touches the underside of the orifice plate 37, as shown in Figure 4. Thus, the wick 107 delivers liquid from within the liquid reservoir 31 by capillary action to the underside of the orifice plate 37, which upon vibration, causes the liquid to pass through its orifices and be ejected from its opposite side (i.e., the upper surface) in the form of very small droplets.

It will be appreciated from the foregoing that the horizontal platform 25 serves as a common structural support for both the liquid reservoir assembly 80 and the atomizer assembly 34. Thus, the horizontal platform maintains the liquid reservoir assembly 80, and particularly, the upper end of the wick 107, in alignment with the orifice plate 37 of the atomizer assembly 34. Moreover, because the atomizer assembly 34 and the orifice plate 37 are resiliently mounted, the upper end of the wick 107 will always press against the under surface of the orifice plate 37 and/or the actuator element 35 irrespective of dimensional variations which may occur due to manufacturing tolerances when one liquid reservoir is replaced by another. This is because if wick 107 of the replacement liquid reservoir assembly 80 is higher or lower than the wick 107 of the original liquid reservoir assembly 80, the action of the spring 43 will allow the orifice plate 37 to move up and down according to the location of the wick 107 in the replacement reservoir assembly 80, so that the wick 107 will always press against the underside of the orifice plate 37 and/or the actuator element 35. It will be appreciated that the wick 107 should be of a solid, dimensionally stable material so that it will not become deformed when pressed against the underside of the resiliently supported orifice plate 37.

As can be seen in Figure 4, the wick 107 extends from inside the liquid reservoir 31 up through the plug 33 in the top of the reservoir 31 to contact the orifice plate 37 and/or the actuator element 35 from near the bottom of the liquid reservoir 31. The wick 107 has longitudinally extending capillary passages which draw liquid up from within the container 31 to the upper end of the wick 107.

The wick 107 preferably includes an integrally formed attachment assembly for securing the wick 107 to the plug 33. Of course, the attachment assembly may be a separate piece affixed to the wick 107. The attachment assembly includes a collar 102 having a lower segment 104 of a relatively large diameter and an upper segment 106 of a relatively small diameter. The top of the lower segment 104 contacts the plug 33 to prevent the wick 107 from moving out of the container 31. The upper segment 106 frictionally fits into the aperture in the plug 33.

As also can be seen in Figure 4, the upper end of the wick 107 enters into an opening in the bottom of the spring housing 39 to supply liquid to a location just below or on the bottom surface of the orifice plate 37. The wick 107 may be substantially in contact with a flange portion on the periphery of the domed portion of the orifice plate 37, or the actuator element 35. However, the wick 107 includes a top surface having different levels so that a portion of the wick 107 is not in contact with the orifice plate 37 or the actuator element 35. This portion provides unobstructed passage to the atmosphere.

Again, other atomization devices may be substituted as desired in consideration of design choices, manufacturing costs, etc. Also, a more detailed explanation of the atomization device 70 may be found in copending U.S. Patent Application No. 10/412,911, filed April 14, 2003. Also, an atomization device is only one type of dispenser that may be used, and others may be substituted in view of design considerations.

With respect to Figure 2, this embodiment also includes the controller 30. The controller 30 produces and outputs the signals that control the repellant dispenser 24, attractant dispensers 22a-22d, and insecticide dispensers 23. The controller 30 is preferably positioned in or near a central portion of the predefined areas 20 and 20a. This placement is for the convenience of the users, and in other embodiments the position of the controller 30 may be varied.

The controller 30 may produce the control signals according to direct input from a user on user interface 38, set programs stored in a memory, signals from sensor 26, or combinations thereof. The control signals may be provided to the various dispensers through a direct connection from wires 42, in which case, the control signals may be in the form of voltages or coded pulses (or other coded signals). Alternatively, the controller 30 may have a single output terminal connected via a common bus to the different dispensers. In such a case, the coded signals are provided with appropriate addresses to ensure that they are recognized only by the particular dispenser to which they are directed. More preferably, coded signals with addresses are transmitted from the controller 30 to the dispensers by wireless means such as by infra-red light or radio signals. In this case, a transmitter 44 may be provided with the controller 30 to transmit the control signals to the interfaces 98 of each of the

various dispensers. In alternative embodiments, the transmitter 44 may be a transceiver, which both sends and receives signals. In this case, the transmitter 44 may receive signals from the interfaces 98 of the dispensers, indicating, for instance, a level of fluid remaining in the fluid reservoir 31. Alternatively, the transmitter 44 may receive signals from remotely positioned sensors, which may also be connected by wired or wireless means. Those sensors may be positioned at any one of a number of locations throughout areas 20 and/or 20a.

In this embodiment, a single sensor 26 is provided integrally with the controller 30. The sensor may detect a single ambient condition, or a plurality of conditions.

The sensor 26 may be assembled to detect a number of various ambient conditions such as the presence of insects, temperature, direction of airflow (i.e., wind), speed of airflow, humidity, sound, light, chemical content of the surrounding air, etc. While the system according to our invention can be configured such that the controller 30 controls the different insect control devices based on a stored program, user instructions provided through the interface 98, and a timing mechanism, it is preferred that the controller 30 control the insect control devices based, at least in part, from signals from the sensor 26, indicating ambient conditions.

Thus configured, this embodiment of our invention can define discrete areas in which insects are to be controlled using a pattern of dispensers including one or more attractant dispensers, one or more repellant dispensers, and/or one or more insecticide dispensers. With the area defined, the various dispensers can be independently controlled by the controller 30 to dispense insect control agents in an efficient and effective manner to provide an area in which the insect population may be reduced and/or into which the flow of insects is reduced. Thus, users can enjoy the controlled area without the level of insects that they otherwise would have to endure.

The controller 30 may control the operation of the various dispensers in a number of different ways to achieve this end, as would be understood by one of ordinary skill in the art.

In a preferred embodiment, the sensor 26 detects both the wind speed and wind direction relative to the controller 30, and the dispensers are controlled based on those factors, as discussed below for exemplary purposes.

For instance, the control system may include indicia 32a-32d which indicate directions from the controller 30 in which each of the attractant dispensers 22a-22d are to be positioned. More specifically, the attractant dispensers 22a-22d may be marked such that dispenser 22a is to be placed fifteen feet from the controller 30 in the direction indicated by indicia 32a. (Of course, the exact distances are provided only as examples, and our invention is not limited thereby.) The other attractant dispensers 22b-22d may be similarly positioned with respect to indicia 32b-32d. In addition, the repellant dispenser 24 may be provided integrally with the controller 30 (as shown in Fig. 3) so as to avoid the need for placement by a user. (Alternatively, the repellant dispenser 24 and sensor 26 may be provided separate from the controller 30, at positions that may be indicated by other indicia. Also, other conventional mechanisms may be used to provide a relative arrangement of sensors and dispensers such that the controller 30 may adequately and efficiently operate the dispensers to control insects in the areas 20 and 20a and to conserve resources.)

With the system thus positioned, the controller 30 can be preprogrammed with the relative positions of each of the dispensers and sensor 26, to set the appropriate control signals for each dispenser based on the signals from the sensor 26. For instance, when the sensor 26 detects that the direction of the wind across the predetermined area follows a line from indicia 32b to indicia 32d, and that the wind speed is five mph, the controller 30 can set the appropriate control signals based on those factors to keep a portion of the predetermined area to be occupied by users free of attractant. For instance, the controller 30 could reduce or cut-off the attractant being dispensed by attractant dispenser 22b, so that the attractant is not carried by the wind into the central portion of area 20, while increasing the output of other attractant dispensers. Alternatively, the sensed conditions could be used to determine when to use airborne insect control agents verses agents such as electromagnetic waves that are not affected by wind speed or direction.

Also, the output of the repellant dispenser 24 may be controlled by the controller 30 based on the signals from the sensor 26, such that the output is increased when the wind speed increases to maintain an adequate supply of repellant in the central area of area 20. Alternatively, a plurality of repellant dispensers 24 may be provided, with the plurality being arranged around a central portion of predetermined area 20, closer in than are positioned the attractant dispensers 22a-22d. These repellant dispensers 24 could also be located at positions indicated by indicia 32a-32d, at a distance of five feet. from the controller 30. With this configuration, the various repellant dispensers 24 may be operated in a manner opposite to attractant dispensers 22 to increase the concentration of repellant in the users' area based on the sensed wind speed and direction.

While these various configurations have been explained with the controller 30 centrally located, one of ordinary skill would understand that the placement of the various dispensers, controller and sensor(s) may be varied with the position and operation of the sensors being operated accordingly.

Figure 5 shows a circuit diagram for one possible arrangement of components for the controller 30, as well as connected items. In this embodiment, the controller 30 is powered by a battery (not shown) through battery contacts 64; however, other sources of power, such as an AC current source, may also be used. A power supply 66 draws power from the battery through the battery contacts 64 and then supplies 3.3 volts to the controller 30. In other embodiments, the current level (or voltage level) use may be altered as desired or necessary for the components to be powered.

The microcontroller or (ASIC) 50 controls the operation of the controller 30, and is powered by power supply 66. (The power supply 66 may also power the sensor(s) and dispensers, if a wired connection is provided among these items. Alternatively, each different item may have its own power supply means.) The microcontroller 50 includes a control logic device 56 that provides the operational instructions to the various dispensers in accordance with input signals or internal programs. The input signals may be signals from the sensor 26, which includes individual sensors 27a and 27b (i.e., a sensor for wind speed and a sensor for

wind direction, in this embodiment). The sensor 26 sends input signals to inputs 52. The inputs 52 transfer the signals to the control logic device 56. Alternatively, input signals may be provided by user interface 38, which also provides signals to inputs 52. In other embodiments, the control logic device 56 may be run by a combination of signals from the sensor 26 and the user interface 38. Further, memory 54 is provided to store programs that may also provide signals to the control logic device 56, on their own, or in cooperation with other signals (from the sensor 26 or the user interface 38, for instance).

Having received one or more signals from the sensor 26, user interface 38, memory 54, or the combination thereof, the control logic device 56 sends a signal for controlling the operation of the array of dispensers to output driver 58. Preferably, pulse width modulation is used to drive and to control the dispensers, and the output driver 58 sets the duty cycles for the operation of the dispensers based on the instructions from the control logic device 56. Thus configured, the duty cycles can be used to control the frequency of bursts of emission of attractant, repellent, or insecticide to adjust the rate at which the corresponding chemicals are dispensed (when chemical dispensers are used), and thus, the potency of each substance in the air. Of course, when dispensers other than piezoelectrically actuated atomization devices emitting chemicals are used, the control signals may be made to provide suitable control for the specific device. Also, pulse width modulation is only one control mechanism, and other signal forms may be used by the output driver 58.

The microcontroller 50 may also include a timing mechanism 60 and an oscillator 62. The timing mechanism 60 and oscillator 62 control the operation of microcontroller 50 in accordance with the set program or other settings from the sensor 26, user interface 38, and/or memory 54.

The output driver 58 may provide the control signals to the various dispensers by direct wiring, as discussed above. Preferably, however, transmitter 44 is provided. The transmitter 44 receives the control signals from the output driver 58 and wirelessly transmits the signals via antenna 46 to the interfaces 98 of dispensers 22a-22d (and insecticide dispensers 23, when provided). In this embodiment, the repellant dispenser 24 is provided integrally with

the controller 30, and thus may be directly wired to output driver 58. In other embodiments, transmitter 44 may be used to send signals to the repellant dispenser 24.

As discussed, this is only one arrangement for the controller 30. As would be understood by one of ordinary skill in the art, other arrangements are possible for the controller 30.

Figure 6 shows an example of one program for controlling the control logic device 56 of the microcontroller 50. In step S1, the control logic device 56 checks the settings of the user interface 38. In step S2, the control logic device 56 determines whether the controller 30 is set on a "manual" or an "auto" operation. If the controller 30 is set on manual operation, the program proceeds to step S3 in which it is determined whether a "low" setting has been programmed at the user interface 38. If a low setting is not indicated, the program proceeds to step S4 in which it is determined whether the user interface is set on a "medium" setting. If it is not set on medium, the program proceeds to step S5 in which the control logic 56 sends a "high" signal to all dispensers through output driver 58, so that the dispensers emit their respective agents at the highest levels.

If, however, in step S3, a low setting is detected, the program proceeds to step S7 in which a low signal is transmitted to all dispensers, and the dispensers emit their respective agents at the lowest levels. If, in step S4, it is determined that the user interface 38 is set on a medium setting, the program proceeds to step S8 in which a medium signal is transmitted to all dispensers. In step S6, the program returns to the start.

If an auto setting is detected in step S2, the program proceeds to step S9. In step S9, the sensor 26 senses the wind speed and wind direction. In step S10, the controller 30 determines, from the sensed conditions, whether the wind speed is fifteen mph or greater. If it is not, the program proceeds to step S11, in which, based on signals from the sensor 26, it is determined whether the wind speed is less than three mph. If the answer is no, the program proceeds to step S12 in which a "look up" table 110 stored in memory 54 is used to determine the optimum output for each dispenser based on the ambient conditions sensed by

sensor 26. In step S13, appropriate control signals are transmitted to the various dispensers based on the output of the table 110.

If, in step S10, it is determined that the wind speed is fifteen mph or greater, the program proceeds to step S15, in which a signal is transmitted to all dispensers to turn off. If, in step S11, it is determined that the wind speed is less than three mph, the program proceeds to S16 in which a low signal is transmitted to all dispensers.

At step S14, the program returns to the start.

Figure 7 shows the content of the "look-up" table 110. The table 110 provides instructions on how to operate each of four attractants/insecticide dispensers positioned at North (N), South (S), East (E), and West (W) positions. The table 110 also refers to the locations of four repellant dispensers. Although one repellant dispenser 24 is typically used, and provided integrally with the controller 30 (as shown in Fig. 2), multiple repellant dispensers 24 may be provided, as discussed above. Consequently, we have shown the table 110 with information for four dispensers for exemplary purposes. When one dispenser is used, it may be preferred that it be controlled with respect to wind speed, but not direction.

Also, while the table 110 is described with respect to these North, South, East, and West positions, these are also provided only for exemplary purposes. The system may be set up such that the attractant dispensers 22a-22d are not positioned exactly in these relative directions from the controller 30. In that case, the relative direction of the wind with respect to the positions of the sensors may be taken into account as necessary so as to properly and efficiently control the emission of insect control agents.

Based on the operation of the program shown in Figure 6, at step S12, when the wind speed is equal to or greater than three mph and less than fifteen mph, the table 110 is consulted to control the operation of the different dispensers based on the wind direction sensed by the sensor 26.

For instance, when the wind is blowing from the North, as shown in the first row of the table 110, the northerly located attractant dispenser (i.e., attractant dispenser 22b in Fig. 2) is shut off, the southerly located dispenser (i.e., attractant dispenser 22d) is set on high, and the easterly and westerly located dispensers (i.e., attractant dispensers 22c and 22a, respectively) are set on medium. Thus, an attractant is prevented, to at least some degree, from being blown into a user-occupied portion of area 20, when an airborne agent is used, as discussed above. Insecticide dispensers, when used, are preferably provided with the same settings at the attractant dispensers, when positioned in similar locations and of the type that emit airborne agents.

Also, when using four repellant dispensers, the table 110 sets their operation in a manner substantially opposite to that of the attractant dispensers, such that, with respect to the first row, a northerly positioned repellant dispenser is set on high and a southerly positioned repellant dispenser is shut off (with the easterly and westerly dispensers being set on medium). Consequently, the insect repellant can be concentrated in area 20.

As discussed, this example is directed to an embodiment in which airborne chemicals are used as the attractants, repellants and insecticides. It would be readily understood by one of ordinary skill in the art, that the operation of the dispensers would be varied and different "look-up" tables would be provided for embodiments in which other types of dispensers, or combinations of different types of dispensers, are used. For instance, when dispensers which do not emit airborne chemicals are used (i.e., ones using electromagnetic waves), the wind speed and direction could be used to determine the manner in which insects are most likely to fly through the area 20, and the dispensers can be operated based on that information. Also, other ambient conditions can be sensed such as light, such that the dispensers may be elevated at dusk, for instance, when insects are most active. Numerous other variations are also possible while keeping with the spirit of our invention.

Many different embodiments may be constructed without departing from the spirit and scope of our invention. It should be understood that our invention is not limited to the specific embodiments described in this specification. To the contrary, our invention is

intended to cover various modifications and equivalent arrangements included within the spirit and scope of our invention as defined by the claims. The scope of the claims is to be accorded the broadest interpretation so as to encompass all such modifications, equivalent structures and functions.

INDUSTRIAL APPLICABILITY

Our invention is applicable to settings or areas in which insects are to be repelled, attracted, killed, or otherwise controlled. Our invention provides suitable systems for efficiently and effectively controlling the emission of insect control agents to affect the control of insects in an area to be controlled.

We claim:

1. An insect control system comprising:

a plurality of dispensers for emitting an insect control agent, each dispenser being independently positionable, and the insect control agent being at least one of insect repellant, insect attractant and insecticide;

a controller for controlling the emission of the insect control agent from each of the plurality of dispensers; and

a sensor for sensing an ambient condition,

wherein the controller controls the emission of the insect control agent from each of the plurality of dispensers, individually, based on the ambient condition sensed by the sensor.

2. The insect control system according to claim 1, wherein the controller controls the emission of the insect control agent from each of the plurality of dispensers, individually, based on the ambient condition sensed by the sensor and positions of the dispensers relative to each other.

3. The insect control system according to claim 2, wherein the controller is preprogrammed with at least one pattern setting indicating relative positions preassigned to the plurality of dispensers, and each dispenser is to be positioned by a user at its respective preassigned position in the pattern during use.

4. The insect control system according to claim 3, wherein the controller is preprogrammed with a plurality of different pattern settings, and a user positions the dispensers according to the pattern setting selected in the controller.

5. The insect control system according to claim 2, wherein one pattern setting is set such that:

(i) the dispensers define a predetermined area;

(ii) a dispenser in a central portion of the predetermined area emits insect repellant; and

(iii) a plurality dispensers located at a peripheral portion of the predetermined area emit insect attractant.

6. The insect control system according to claim 5, wherein the insect attractant is a chemical, the sensor senses at least one of the speed and relative direction of air flow in the predetermined area, and the controller controls the amount of insect attractant emitted, per unit time, by the plurality dispensers located at the peripheral portion of the predetermined area based on at least one of the speed and relative direction of the air flow in the predetermined area sensed by the sensor.

7. The insect control system according to claim 6, wherein the insect repellant is a chemical, and the controller controls the amount of insect repellant emitted, per unit time, by the dispenser located at the central portion of the predetermined area based on at least one of the speed and relative direction of the air flow in the predetermined area sensed by the sensor.

8. The insect control system according to claim 7, wherein the dispensers located at the peripheral portion of the predetermined area also emit insecticide.

9. The insect control system according to any one of claims 1-3, wherein the sensor senses at least one of sound, temperature, humidity, light, and airborne chemicals.

10. The insect control system according to any one of claims 1-3, wherein the sensor senses at least one of the speed and relative direction of air flow.

11. The insect control system according to any one of claims 1-3, wherein the insect control agent is a chemical and each dispenser of the plurality of dispensers is an atomizer device that ejects droplets of the insect control agent into the surrounding environment.

12. The insect control system according to any one of claims 1-7, wherein the controller communicates with the dispensers by way of at least one of radio waves, infrared signals and acoustical signals.

13. The insect control system according to any one of claims 1-5, wherein at least one of the dispensers is a lamp and the insect control agent emitted from the lamp is electromagnetic waves.

14. The insect control system according to any one of claims 1-5, wherein at least one of the dispensers is an acoustical generator and the insect control agent emitted form the acoustical generator is sound waves.

15. The insect control system according to any one of claims 1-5, further comprising a lamp, wherein the controller controls the lamp to provide visible ambient light.

16. The insect control system according to claim 15, wherein the lamp comprises a plurality of LEDs for emitting different color lights.

17. The insect control system according to either of claims 1 or 2, wherein

(i) the dispensers define a predetermined area;

(ii) a dispenser in a central portion of the predetermined area emits insect repellant; and

(iii) a plurality dispensers located at a peripheral portion of the predetermined area emit insect attractant.

18. The insect control system according to claim 17, wherein a plurality of dispensers located at the peripheral portion of the predetermined area emit insecticide.

19. An insect control system comprising:

a plurality of dispensers for emitting an insect control agent, the insect control agent being at least one of an agent for repelling insects, an agent for attracting insects, and an agent for killing insects;

a controller for remotely controlling the emission of the insect control agent from each of the plurality of dispensers; and

a sensor for sensing an ambient condition,

wherein the controller controls the emission of the insect control agent from each of the plurality of dispensers based on the ambient condition sensed by the sensor.

20. The insect control system according to claim 19, wherein

(i) the dispensers define a predetermined area;

(ii) a dispenser in a central portion of the predetermined area emits insect repellant; and

(iii) a plurality dispensers located at a peripheral portion of the predetermined area emit insect attractant.

21. The insect control system according to claim 20, wherein a plurality of dispensers located at the peripheral portion of the predetermined area emit insecticide.

22. The insect control system according to claim 20, wherein the insect attractant is a chemical, the sensor senses at least one of the speed and relative direction of air flow in the predetermined area, and the controller controls the amount of insect attractant emitted, per unit time, by the plurality dispensers located at the peripheral portion of the predetermined area based on at least one of the speed and relative direction of the air flow in the predetermined area sensed by the sensor.

23. The insect control system according to claim 22, wherein the insect repellant is a chemical, and the controller controls the amount of insect repellant emitted, per unit time, by the dispenser located at the central portion of the predetermined area based on at

least one of the speed and relative direction of the air flow in the predetermined area sensed by the sensor.

24. The insect control system according to claim 23, wherein the dispensers located at the peripheral portion of the predetermined area also emit insecticide.

25. The insect control system according to either of claims 19 and 20, wherein the sensor senses at least one of wind speed, relative direction of air flow, sound, temperature, humidity, light, and airborne chemicals.

26. The insect control system according to either one of claims 19 and 20, wherein the insect control agent is a chemical and each dispenser of the plurality of dispensers is an atomizer device that ejects droplets of the insect control agent into the surrounding environment.

27. The insect control system according to either one of claims 19 and 20, wherein the controller communicates with the dispensers by way of at least one of radio waves, infrared signals and acoustical signals.

28. The insect control system according to either one of claims 19 and 20, wherein at least one of the dispensers is a lamp and the insect control agent emitted from the lamp is electromagnetic waves.

29. The insect control system according to either one of claims 19 and 20, wherein at least one of the dispensers is an acoustical generator and the insect control agent emitted form the acoustical generator is sound waves.

30. The insect control system according to either one of claims 19 and 20, further comprising a lamp, wherein the controller controls the lamp to provide visible ambient light.

31. The insect control system according to either one of claims 19 and 20, wherein the lamp comprises a plurality of LEDs for emitting different color lights.

32. An insect control system comprising:

an insect repelling device for repelling insects, operating in a first area;

at least one insect control device, the insect control device being at least one of an insect attracting device and an insect killing device, and the at least one insect control device operating in a second area different from the first area; and

a controller for independently controlling the insect repelling device and the at least one insect control device to operate in their respective areas.

33. An insect control system comprising:

a plurality of insect control devices, the insect control devices including at least one of an insect attracting device, an insect killing device, and an insect repelling device;

a controller for controlling the plurality of insect control devices; and

a sensor for sensing an ambient condition in an area in which insects are to be controlled by the insect control system,

wherein the controller controls the plurality of insect control devices based on the at least one ambient condition sensed by the sensor.

34. An insect control system comprising:

a plurality of insect control devices, the insect control devices being at least one of an insect attracting device, an insect killing device, and an insect repelling device, the plurality of insect control devices being independently arranged in an area in which insects are to be controlled; and

a controller for independently controlling the plurality of insect control devices to control insects in the area to be controlled.

35. An insect control system comprising:

a plurality of insect control devices, the insect control devices being at least one of an insect attracting device, and an insect killing device, and an insect repelling device, the plurality of insect control devices being independently arranged in an area in which insects are to be controlled;

a lamp for providing ambient light; and

a controller for independently controlling the plurality of insect control devices to control insects in the area to be controlled and the lamp to emit light.

36. The insect control system according to claim 35, wherein the lamp comprises a plurality of LEDs for emitting different color lights.

37. An insect control system for controlling insects within a predetermined area, the system comprising:

a plurality of insect control devices distributed throughout the predetermined area, the insect control devices including at least one device that emits an insect repellant and at least one spaced apart device that emits an insecticide and/or at least one adjacent device that emits an insect attractant;

at least one sensor which senses at least one ambient condition and emits one or more corresponding signals; and

a central control device which is arranged to respond to the corresponding signals and to emit activation signals which control the operation of the insect control devices according to the corresponding signals.

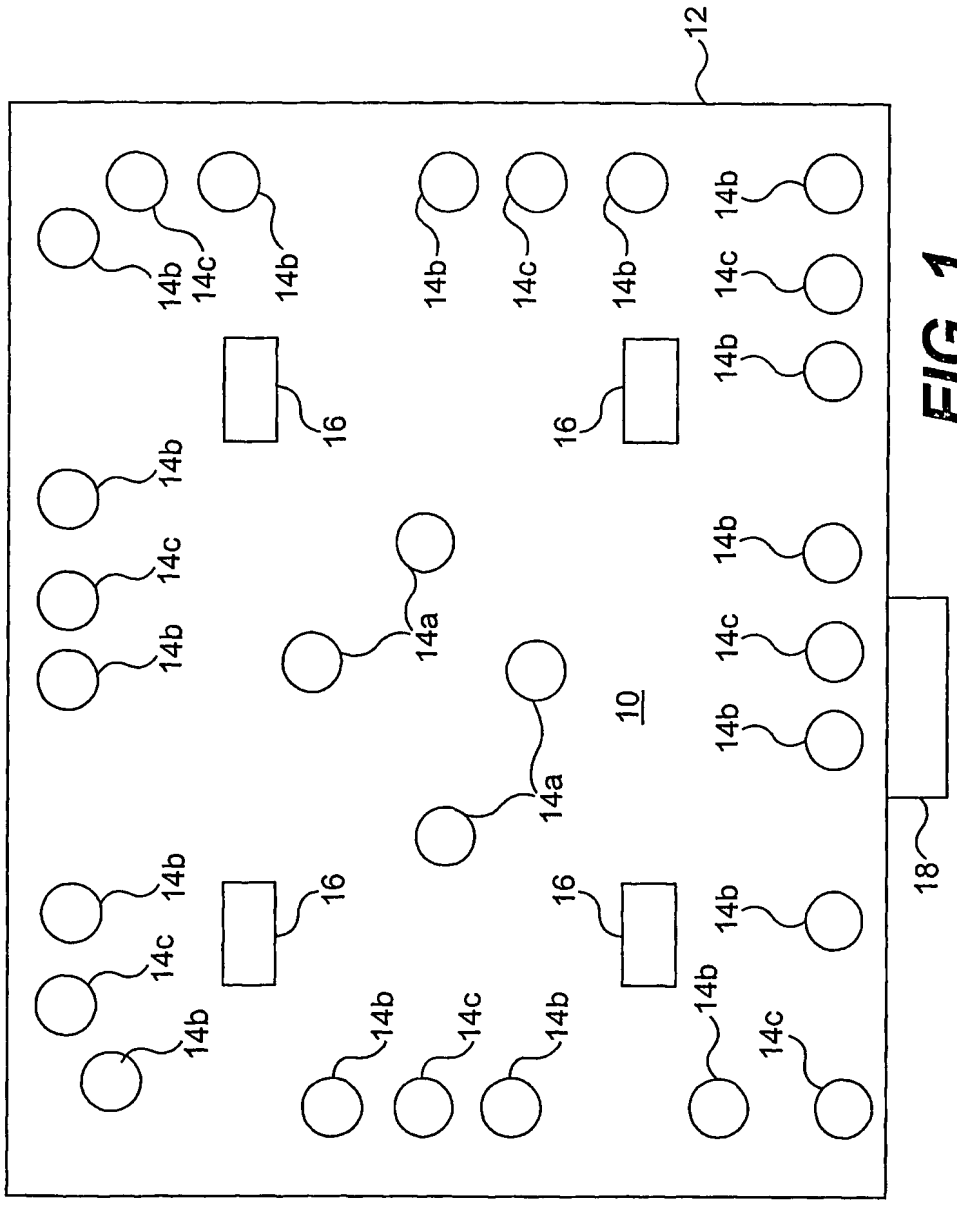


FIG. 1

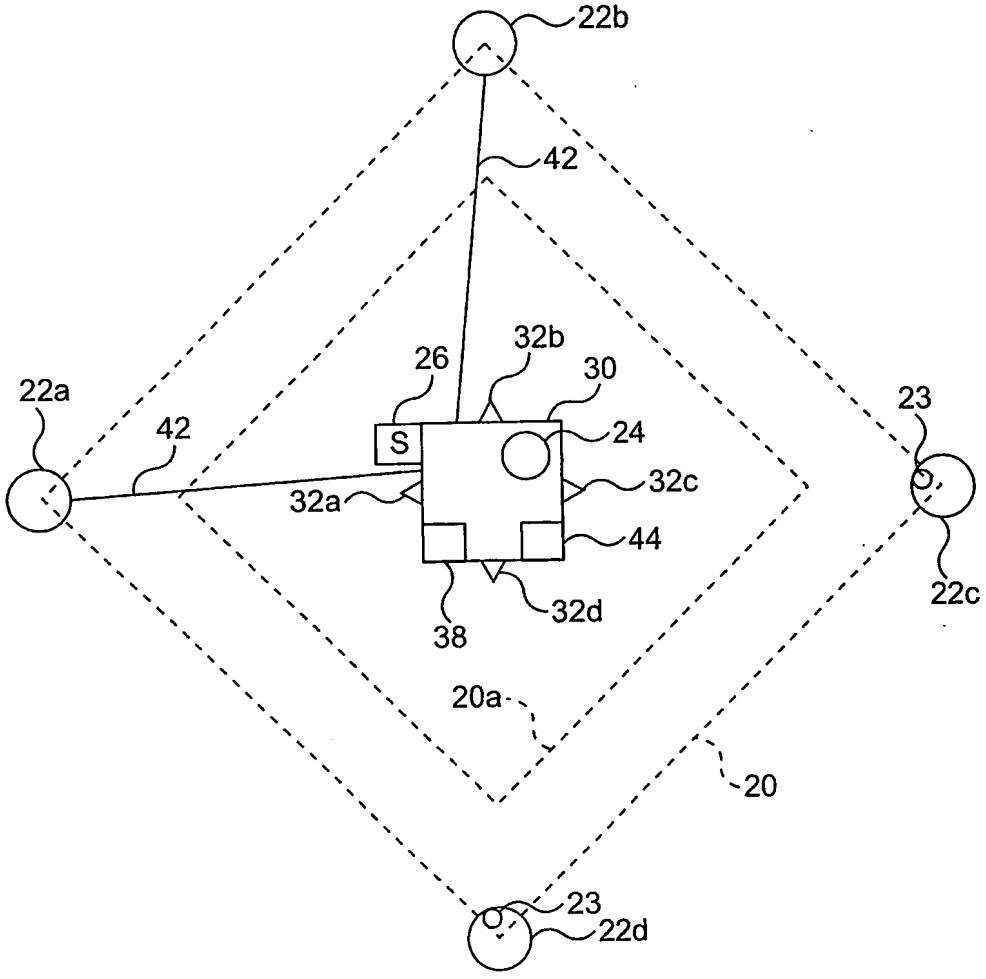


FIG. 2

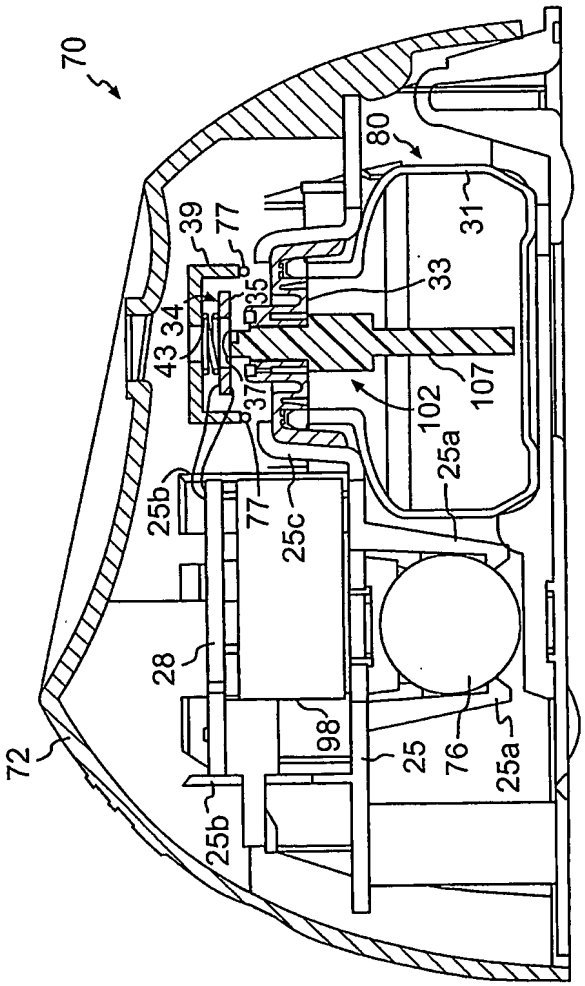

70
80
31
39
77
35
33
43
34
37
102
107
25a
25b
77
25c
28
98
25
76
25a
72
25b

FIG. 3

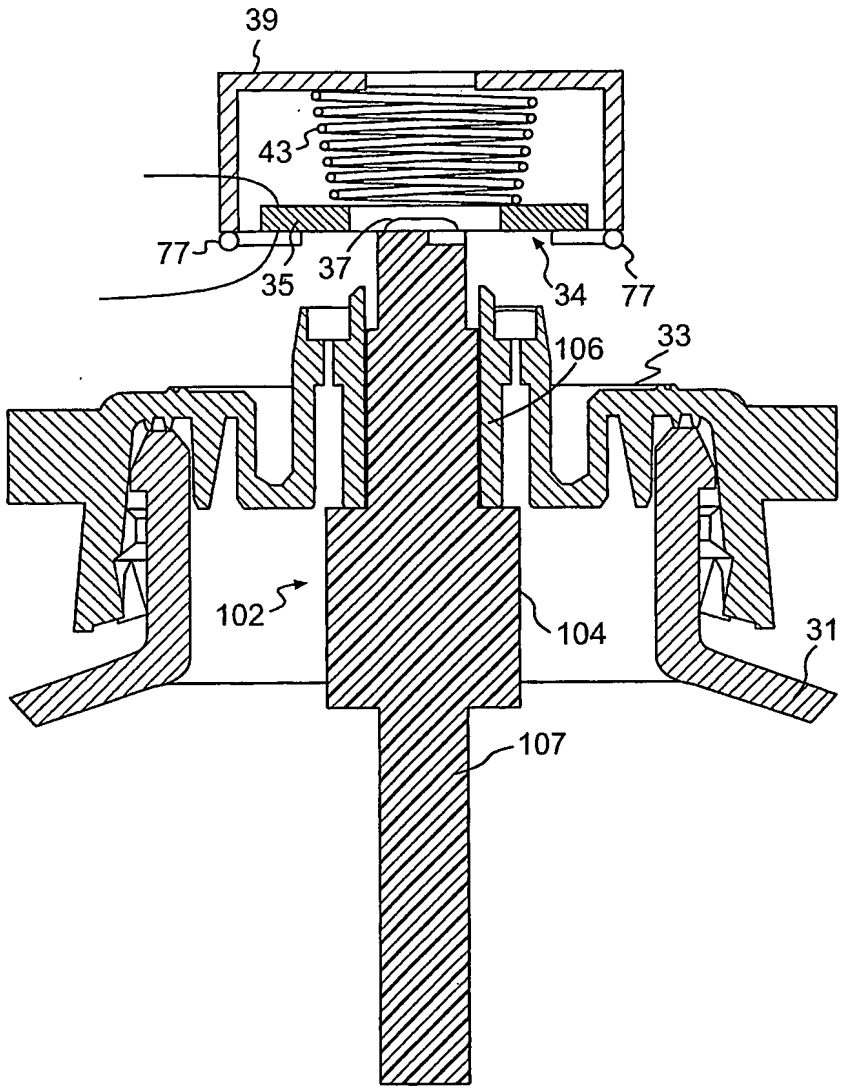


FIG. 4

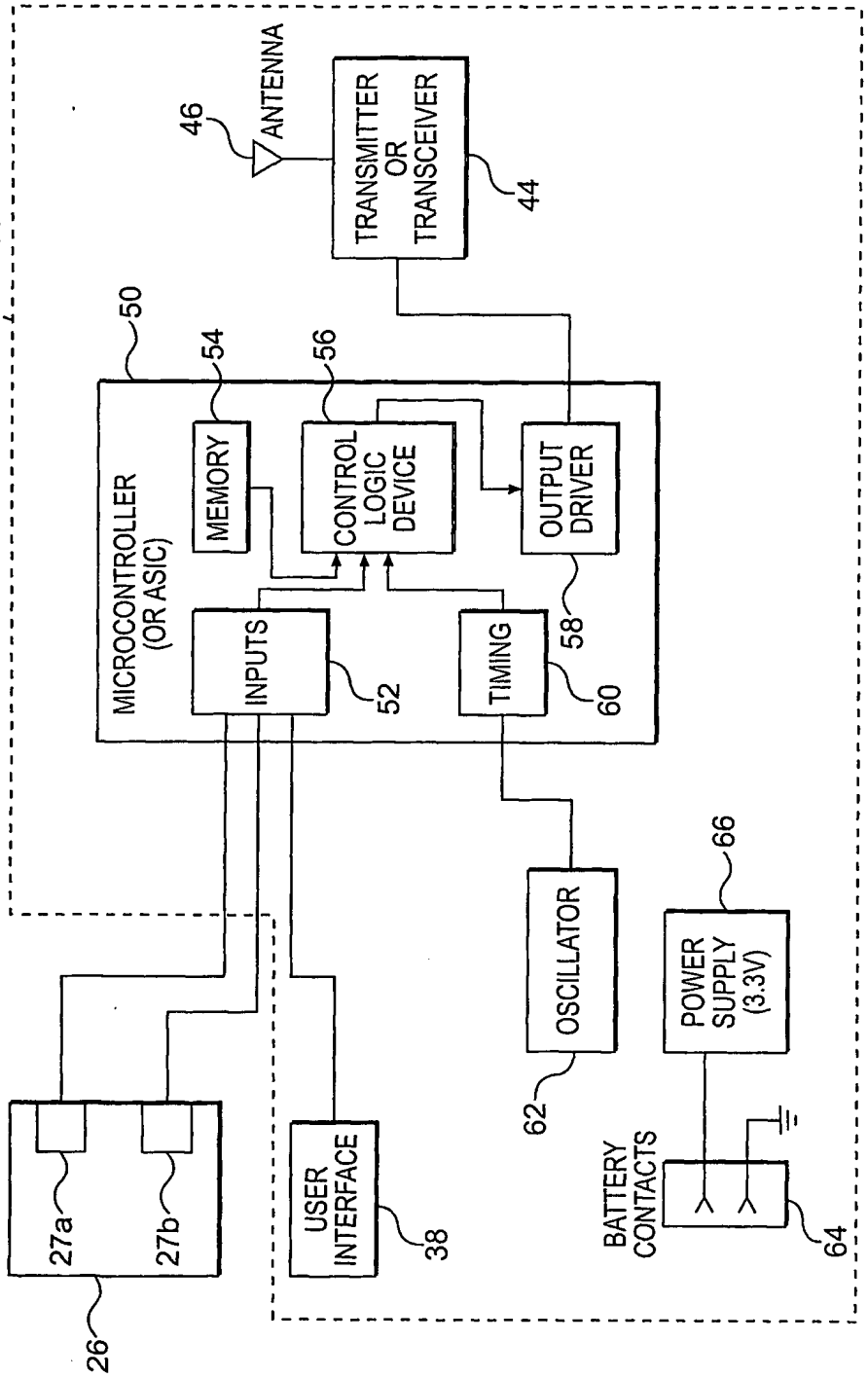

30
46
ANTENNA
TRANSMITTER OR TRANSCEIVER
44
50
54
56
MICROCONTROLLER (OR ASIC)
MEMORY
CONTROL LOGIC DEVICE
OUTPUT DRIVER
INPUTS
52
TIMING
60
58
66
OSCILLATOR
POWER SUPPLY (3.3V)
62
BATTERY CONTACTS
64
USER INTERFACE
38
27a
27b
26

FIG. 5

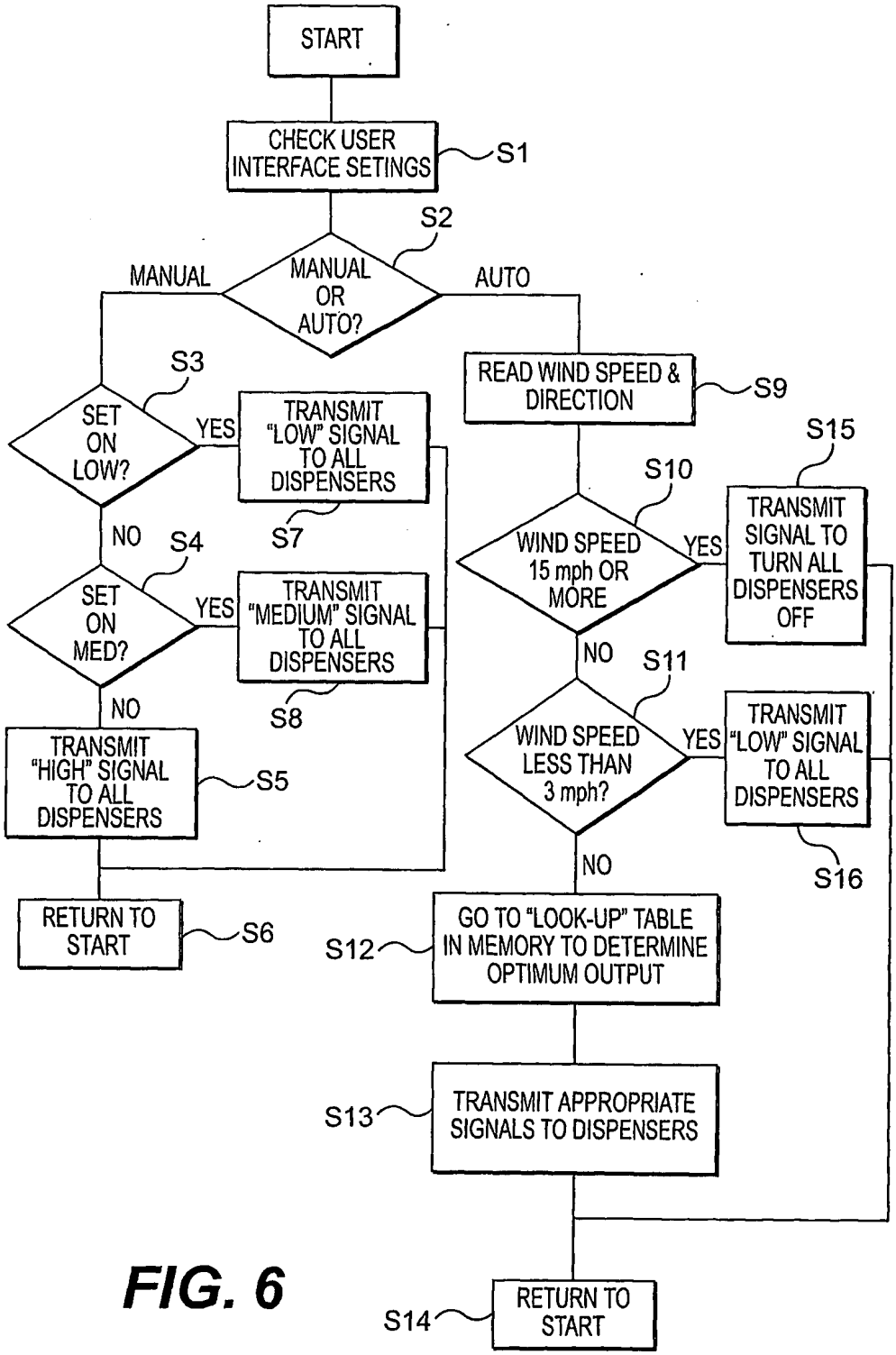

START
CHECK USER INTERFACE SETINGS
S1
S2
MANUAL OR AUTO?
MANUAL
AUTO
S3
SET ON LOW?
YES
TRANSMIT "LOW" SIGNAL TO ALL DISPENSERS
S7
NO
S4
SET ON MED?
YES
TRANSMIT "MEDIUM" SIGNAL TO ALL DISPENSERS
S8
NO
TRANSMIT "HIGH" SIGNAL TO ALL DISPENSERS
S5
RETURN TO START
S6
READ WIND SPEED & DIRECTION
S9
S10
WIND SPEED 15 mph OR MORE
YES
S15
TRANSMIT SIGNAL TO TURN ALL DISPENSERS OFF
NO
S11
WIND SPEED LESS THAN 3 mph?
YES
TRANSMIT "LOW" SIGNAL TO ALL DISPENSERS
S16
NO
S12
GO TO "LOOK-UP" TABLE IN MEMORY TO DETERMINE OPTIMUM OUTPUT
S13
TRANSMIT APPROPRIATE SIGNALS TO DISPENSERS
S14
RETURN TO START

FIG. 6

"LOOK-UP" TABLE 110

WIND DIRECTION	ATTRACTANT/ INSECTICIDE LOCATION				REPELLENT DISPENSER LOCATION			
	N	S	E	W	N	S	E	W
NORTH	OFF	HIGH	MED	MED	HIGH	OFF	MED	MED
NORTHEAST	LOW	HIGH	LOW	HIGH	HIGH	LOW	HIGH	LOW
EAST	MED	MED	OFF	HIGH	MED	MED	HIGH	OFF
SOUTHEAST	HIGH	LOW	LOW	HIGH	LOW	HIGH	HIGH	LOW
SOUTH	HIGH	OFF	MED	MED	OFF	HIGH	MED	MED
SOUTHWEST	HIGH	LOW	HIGH	LOW	LOW	HIGH	LOW	HIGH
WEST	MED	MED	HIGH	OFF	MED	MED	OFF	HIGH
NORTHWEST	LOW	HIGH	HIGH	LOW	HIGH	LOW	LOW	HIGH

FIG. 7